

CLAIMS

[1] A surface defect inspecting method by irradiating an irradiation light having a predetermined pattern on an inspection target surface, imaging the surface irradiated with the irradiation light and inspecting the inspection target surface based on an obtained image of the inspection target surface;

wherein said irradiation light irradiated from an irradiation face has a mesh-like pattern including meshes of a same shape, each mesh having an irradiation area smaller than a non-irradiation area in a plane normal to the optical axis; and

said inspection target surface is inspected, based on lightness/darkness information of an image area in the obtained image corresponding to a non-irradiated area in the inspection target surface.

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[2] The surface defect inspecting method according to claim 1, wherein if an image obtained when the irradiation light is irradiated on a normal inspection target surface is a normal obtained image and the brightness of the irradiation area in the normal obtained image is defined as a high brightness whereas the brightness of the non-irradiation area is defined as a low brightness; then,

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an intermediate brightness area which is present within the obtained image and which is an area of intermediate brightness between the high brightness and the low brightness is used as a target area.

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[3] The surface defect inspecting method according to claim 1, wherein the image area corresponding to the irradiation area in the inspection target surface is extracted as continuous light areas and these continuous light areas are precluded from the target area.

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[4] The surface defect inspecting method according to claim 1, wherein the image area corresponding to the non-irradiation area of the inspection target surface is extracted for each enclosed dark area, and if an isolated light area is present within said enclosed dark area, this isolated light area is determined as the target area.

[5] The surface defect inspecting method according to any one of claims 1-4, wherein in case the inspection target surface is a curved surface, the mesh-like distribution of the irradiation light from the irradiation face corresponding to the curved surface shape of the inspection target surface is set as a circular or a regular polygonal mesh-like pattern in the obtained image.

[6] A surface defect inspecting apparatus comprising an irradiating means for irradiating an irradiation light having a predetermined pattern on an inspection target surface; an imaging means for imaging the inspection target surface irradiated with the irradiation light; and an image processing means for effecting an image processing on an image obtained by the imaging means;

wherein said irradiating means irradiates, from an irradiation face thereof, an irradiation light having a mesh-like pattern including meshes of a same shape, each mesh having an irradiation area smaller than a non-irradiation area in a plane normal to the optical axis; and

said image processing means, in said image processing, is capable of processing lightness/darkness information of an image area corresponding to a non-irradiated area in the inspection target surface.

[7] The surface defect inspecting apparatus according to claim 6, wherein if an image obtained when the irradiation light is irradiated on a normal inspection target surface is a normal obtained image and the

brightness of the irradiation area in the normal obtained image is defined as a high brightness whereas the brightness of the non-irradiation area is defined as a low brightness, said image processing means includes an intermediate brightness area extracting means for extracting an intermediate brightness area which is present within the obtained image and which is an area of intermediate brightness between the high brightness and the low brightness.

[8] The surface defect inspecting apparatus according to claim 6, wherein said irradiation light of said irradiating means is formed by a plurality of light emitting elements distributed in a mesh-like pattern.

[9] The surface defect inspecting apparatus according to claim 6, wherein the irradiation light of the irradiating means is formed through transmission between narrow slits distributed in a mesh-like pattern.

[10] The surface defect inspecting apparatus according to any one of claims 6-9, wherein in correspondence with a curved surface shape of the inspection target surface, the mesh-like distribution of the irradiation light from the irradiation face corresponding to the curved surface shape of the inspection target surface is set as a circular or a regular polygonal mesh-like pattern in the obtained image.

[11] A surface inspecting apparatus comprising: a plurality of light emitting elements arranged in a predetermined layout pattern; an imaging camera for imaging an inspection target surface irradiated with an irradiation light of the light emitting elements; and an outputting portion for outputting the obtained image information of the imaging camera;

wherein said layout pattern comprises a continuous arrangement of the light emitting elements so as to leave a dark face of a predetermined

shape therewithin; and said imaging camera is disposed so as to receive, on at least one said dark face, the irradiation light of each light emitting element reflected off the inspection target surface.

5 [12] The surface defect inspecting apparatus according to claim 11, further comprising a defect evaluating portion for detecting a defect on the inspection target surface by evaluating an output signal from said outputting portion.

10 [13] The surface defect inspecting apparatus according to claim 11 or 12, wherein said layout pattern comprises a repetitive pattern which repeats itself along a predetermined direction.

15 [14] The surface defect inspecting apparatus according to claim 11 or 12, further comprising a conveying mechanism for moving said inspection target surface along a direction relative to said plurality of light emitting elements and said imaging camera;

 wherein the direction of repetition of said layout pattern comprises said direction of relative movement.

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[15] The surface defect inspecting apparatus according to claim 11 or 12, wherein a light emitting face of said plurality of light emitting elements and an imaging face of said imaging camera are present in a common plane.

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[16] The surface defect inspecting apparatus according to claim 11, further comprising a defect evaluating means for evaluating an output signal from said imaging camera, thus detecting a defect present on said inspection target surface;

30 wherein said defect evaluating means includes an isolated point

extracting portion for determining, as a defect candidate, a prominent brightness area isolated in a lightness/darkness image of said inspection target surface generated from said output signal, and a defect candidate discriminating portion operable to preclude, from the defect candidates, said defect candidate contained within an area indicative of light emitting images of the continuously arranged light emitting elements in the lightness/darkness image.

[17] The surface defect inspecting apparatus according to claim 16, further comprising a preprocessing portion for effecting an image processing such that the brightness level of the continuous light emitting image area in an actual inspection may agree substantially with the brightness level of the light emitting image of the continuously arranged light emitting elements obtained from a normal inspection target surface, said latter brightness level being employed as a reference for generating the lightness/darkness image from the output signal of the imaging camera.

[18] The surface defect inspecting apparatus according to claim 17, wherein a peripheral area including the prominent brightness area precluded from the defect candidate and an unnecessary image area such as a background are integrated and masked as a defect determination non-target area.

, relative to the obtained image and .

a masking operation is effected by determining the isolated point area precluded from the defect candidate together with an unnecessary image areas such as a background as defect determination non-target area.